



national accelerator laboratory

EXP-45

July 31, 1973

ACCELERATOR EXPERIMENT: "x_p" and Non-Linear Magnetic Fields at
Injection

Experiment Dates: May 23, 1973, July 25, 1973

It has been observed by various people ⁽¹⁾ that the difference between the centered closed orbit and an off momentum orbit is very unlike the expected x_p function for the accelerator. The nominal x_p is six-fold periodic and has three maxima per super-period, i.e. strong 18th harmonic. The experimental function shown in Figure 1 appears to have a strong second harmonic and not much periodicity otherwise. The off momentum orbit experiences uncorrected ΔB due to non-linear components of the magnetic field. If these non-linear fields have an appreciable 20th harmonic, the apparent second harmonic in "x_p" might be accounted for by the beat pattern. When closed orbit correction program ⁽²⁾ was applied to the data in Figure 1 to orthogonalize it to x_p a fair 20th harmonic curve shown in Figure 2 was obtained. This data was Fourier analyzed to produce the coarse ΔB plot shown in Figure 3. None of the bumps have been associated with special features of the ring, although the one at F49 is interestingly close to the vertical C-Magnet in the 8-GeV line. New data taken since the installation of the iron-core sextupoles is shown in Figure 4. The appearance of a rather good x_p suggests that the rearranging of the sextupoles was also beneficial at the 20th harmonic as well as at the 61st.

References

1. D. Edwards, T. Collins, R. Stiening, E. Wilson, et. al.
2. J. MacLachlan, IEEE Trans. on Nucl. Sci., NS-20, No. 3, 892 (1973)

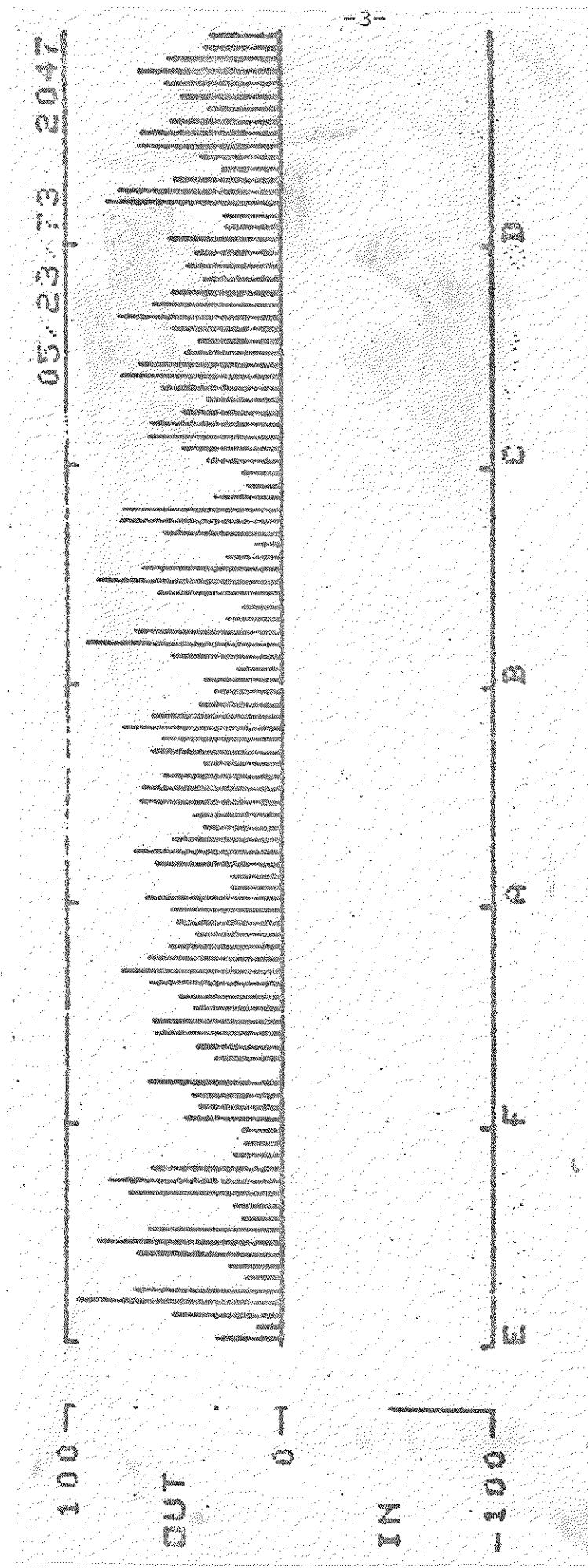


Figure 1 - Off-Momentum Equilibrium Orbit At Injection

AT IT # 0 RMS= 2.31E-01 MAX= 5.08E-01 AT F36 . SCALE = +/- 0.50.

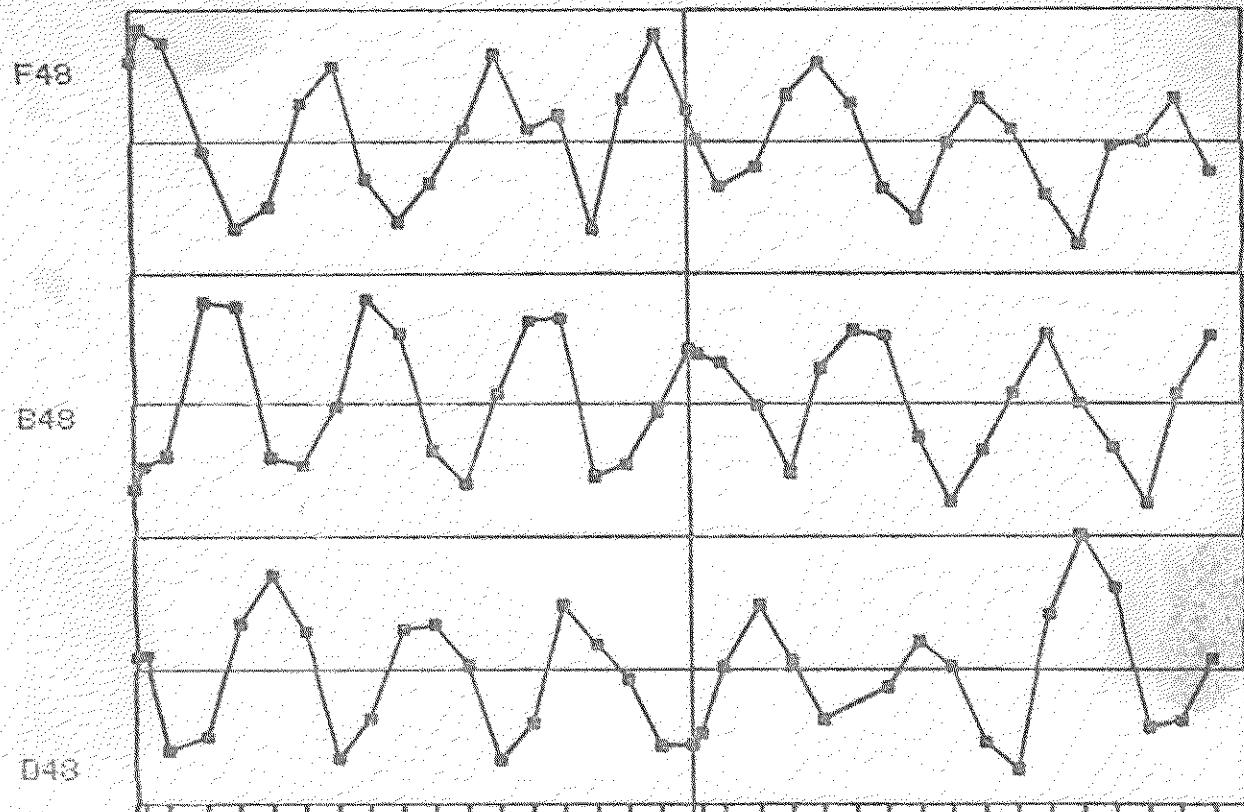


Figure 2 - Off-Momentum Orbit Orthogonalized To x_p

DELTA B/BRHO HAS ABS MAX= 7.06E-03 AT F26.

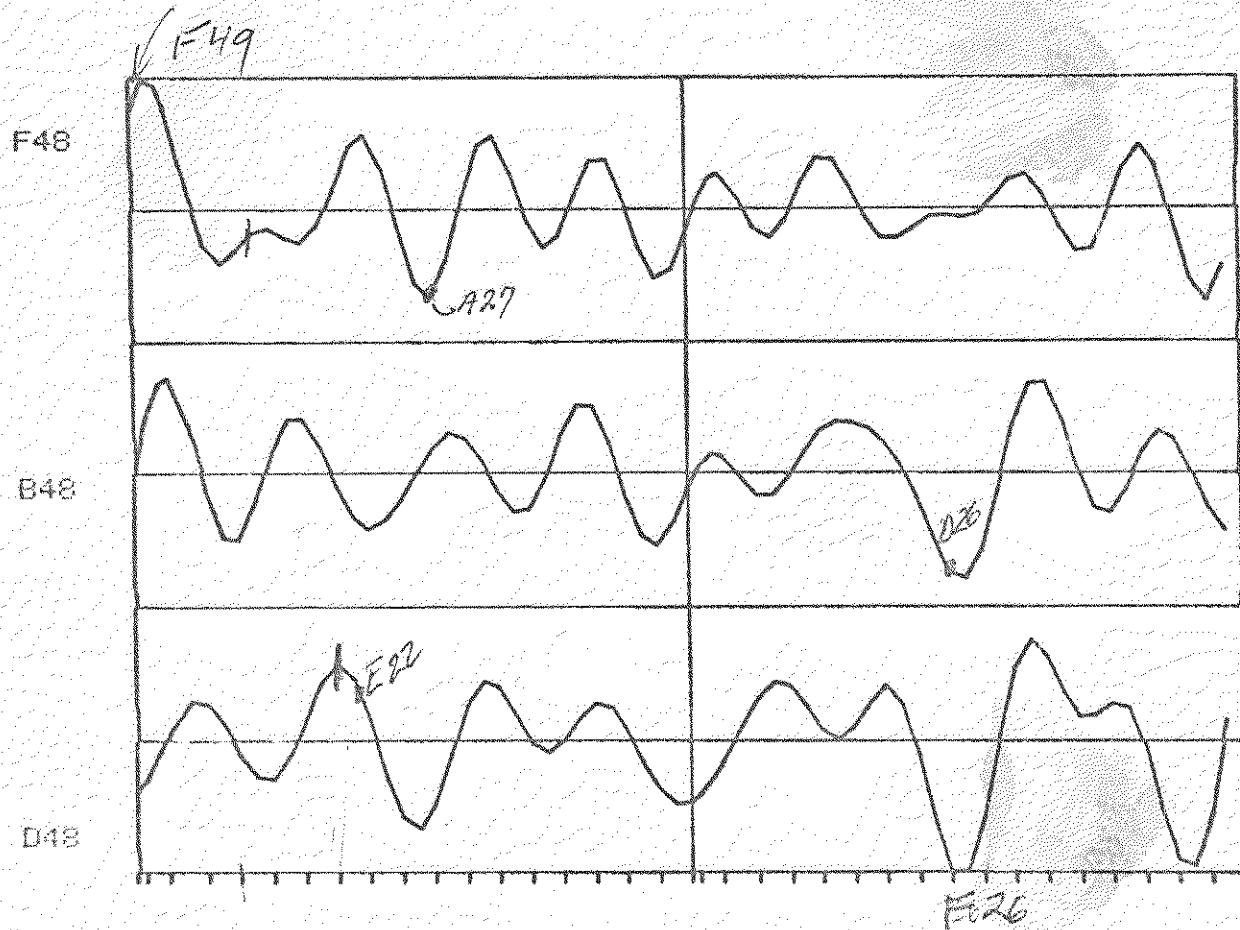


Figure 3 - Distribution of $\beta^{3/2} \Delta B/B_p$ Inferred From
Fourier Analysis Of Data In Figure 2

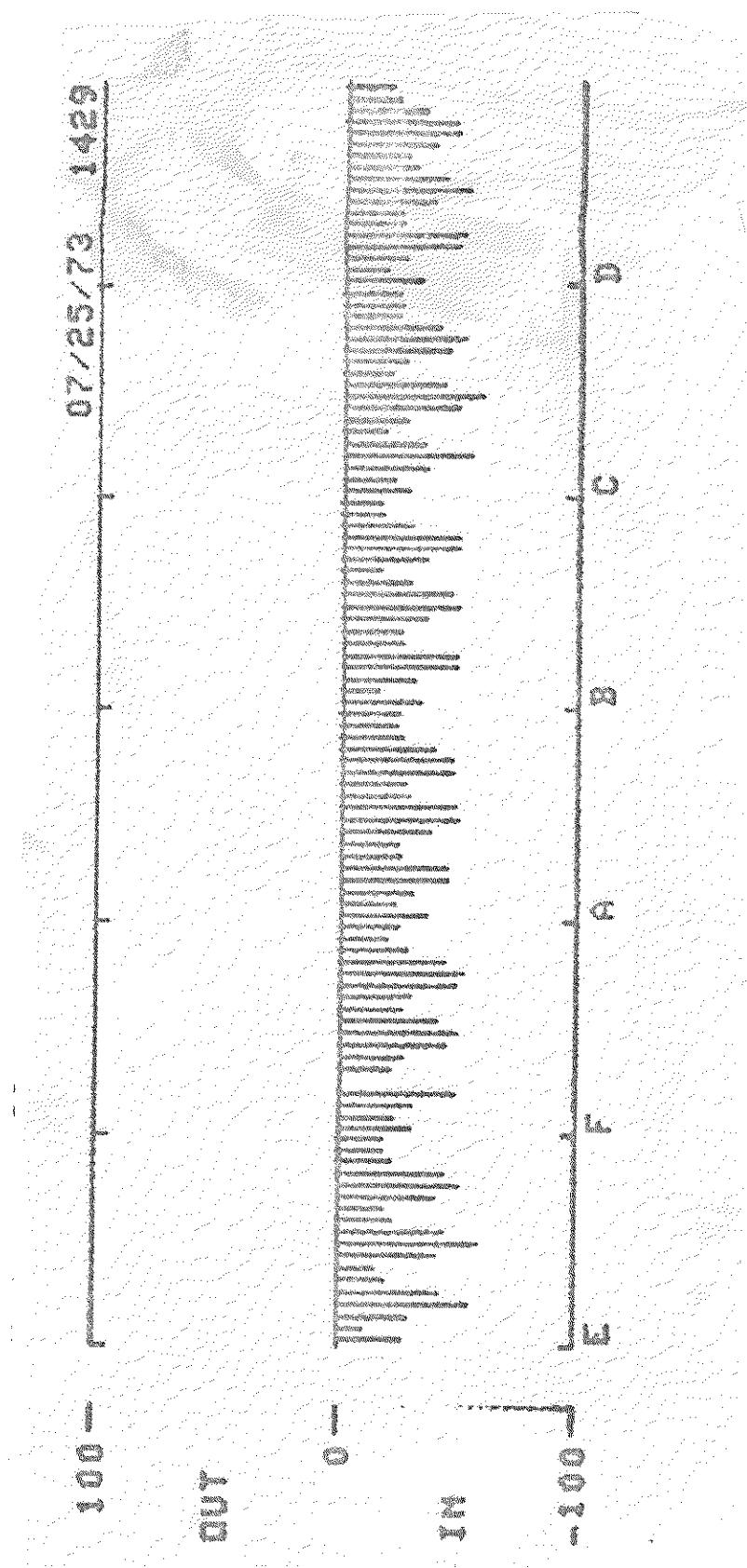


Figure 4 - Off-Momentum Equilibrium Orbit
After Rearrangement Of Sextupoles